Assignment 12.1 p. 567 #19-29 odd, 30, 71, 79

19) $\frac{0.0048 \text{ mol } PH_3}{2.0 \text{ L} \times 1\text{s}} \bigg| \frac{1\text{mol } P_4}{4 \text{ mol } PH_3}$ = **0.00060 mol/Ls P_4**

= **0.0036 mol/Ls H_2** (rate is 6x faster)

21) a. $\frac{-\ 0.500 \text{ M } H_2O_2}{2.16 \times 10^4 \text{ s}} = -2.32 \times 10^{-5}$ M/s H_2O_2

= **1.16×10^{-5} M/s O_2** (O_2 production rate is $^1/_2$ as fast)

b. $\frac{-\ 0.0.250 \text{ M } H_2O_2}{2.16 \times 10^4 \text{ s}} = -1.16 \times 10^{-5}$ M/s H_2O_2

= **5.79×10^{-6} M/s O_2**

23) a. rate = mol/Ls

b. if rate = k [A]o then the unit of k = mol/Ls

c. if rate = k [A] then the unit of k = 1/s

d. if rate = k $[A]^2$

$\frac{\cancel{mol}}{\cancel{L}\,s} = k\left[\frac{mol}{L}\right]^{\cancel{2}}$

k = L/mol s

e. if rate = k $[A]^3$

$\frac{\cancel{mol}}{\cancel{L}\,s} = k\left[\frac{mol}{L}\right]^{\cancel{3}\ 2}$

k = L^2/mol^2 s

25) a. **Rate = k $[NO]^2$ $[Cl_2]$** *when [NO] doubles, rate quadruples*

when $[Cl_2]$ doubles, rate doubles

b. 0.18 = k $[0.10]^2$ [0.10]

k = 180 L^2/mol^2 min

27) a. **Rate = k $[NOCl]^2$** *when [NOCl] doubles, rate quadruples*

b. $5.98 \times 10^4 = k\,[3.0 \times 10^{16}]^2$

k = 6.6×10^{-29} cm^3/molecules•s

c. $\frac{6.6 \times 10^{-29} \text{ mol cm}^3}{\text{molecules} \bullet \text{s}} \bigg| \frac{6.022 \times 10^{23} \text{ molecules}}{1 \text{ mol}} \bigg| \frac{1 \text{ L}}{1000 \text{ cm}^3}$ = **4.0×10^{-8} L/mol s**

29) a. First order for both (when concentration doubles, rate doubles)

b. **Rate = k [Hb] [CO]**

c. 0.619 = k [2.21] [1.00]

k = 0.280 L/µmol s

d. Rate = 0.280 [3.36] [2.40]

Rate = 2.26 µmol/L s

30) a. **Rate = k $[ClO_2]^2$ $[OH^-]$** *when $[ClO_2]$ doubles, rate quadruples*

when $[OH^-]$ doubles, rate doubles

$0.230 = k [0.10]^2 [0.10]$ **k = 230. L^2/mol^2 s**

b. Rate = 230. $[0.175]^2$ $[0.0844]$ = **0.594 mol/L s**

71) a. Rate = k $[NO]^2$ $[O_2]$

When [NO] triples, rate is 9 times faster, so [NO] is second order.

When both [NO] and $[O_2]$ increase by a factor of 2.5, the reaction rate increases by a factor of 15.65 = $(2.5)^3$, so the overall reaction is third order. Thus $[O_2]$ must be first order.

$2.00 \times 10^{16} = k [1 \times 10^{18}]^2 [1 \times 10^{18}]$ k = 2.00×10^{-38} $cm^6/molecules^2$ s

b. Rate = $2.00 \times 10^{-38} [6.21 \times 10^{18}]^2 [7.36 \times 10^{18}]$ = **5.68×10^{18} molecules/cm s**

79) **Rate = k $[I^-]$ $[OCl^-]$ $[OH^-]^{-1}$**

When $[I^-]$ doubles (trials 1-2), rate doubles (first order)

When $[OCl^-]$ triples (trials 3-4), rate triples (first order)

When [OH-] doubles (trials 4-7 or 1-6), rate halves (-1 order)

$9.4 \times 10^{-3} = k [0.0013] [0.012] [0.10]^{-1}$ **k = 60. s^{-1}**